Chapter Four
FACILITY REQUIREMENTS

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To properly plan for the future needs of Show Low Municipal Airport, it is necessary to translate forecast aviation demands into specific types and quantities of facilities that will adequately serve these needs. This chapter uses the results of the aviation demand forecasts developed in the previous chapter to determine the airport capacity, current and future aircraft delay, and future airport facility requirements. Established planning criteria have been applied to the various demand parameters to determine the specific facility requirements for the airfield, as well as the general aviation and potential commuter airline terminal areas of the airport.

The **Facility Requirements** Chapter is intended to identify in general terms the deficiencies in existing facilities and outline what new facilities will be needed to accommodate forecast demands. Once these facility requirements are clearly established, alternatives for providing these facilities can be evaluated in the next chapter to determine the most efficient and cost-effective means of achieving the Master Plan objectives.

AIRFIELD CAPACITY

An airfield capacity analysis for Show Low Municipal Airport was used to determine the existing capacity of the runway system and to identify any present or potential deficiencies. This was accomplished by first determining the capacity of the existing runway and comparing this capacity to the forecast levels of aviation activity.

The methodology used in analyzing airfield capacity is contained in **Airport Capacity and Delay,** FAA Advisory Circular 150/5060-5. This methodology utilizes a combination of variables which provides a more realistic picture of both the ground and air constraints being experienced at U.S. airports than was provided by previous methodologies. The analysis measures the capacity of the airfield in three primary areas: hourly capacity of runways; annual service volume of the runway system; and aircraft delay during peak hour conditions.

Hourly Capacity is a basic measure of capacity that can be related to peak hour activity. The Hourly Capacity of a runway (or runway system) is defined as the maximum number of aircraft operations that can take place in one hour. This measure will be influenced by exit taxiway locations, weather conditions, and level of touch-and-go activity.

Annual Service Volume is a level of airport operational capacity that may be used as a reference in planning the runway system. In general, as annual aircraft operations increase and approach annual service volume, the average delay to aircraft throughout the year increases. When annual aircraft operations are equal to the annual service volume, average delay to each aircraft is approximately one to four minutes. As the number of annual operations exceeds annual service volume, moderate to severe congestion may occur and extended delays may be experienced.

Hourly runway capacity, annual service volume, and aircraft delay are all interrelated and highly dependent on a number of capacity factors. The specific factors to be considered in this analysis included:

- **Meteorological Conditions** - Weather conditions as they affect runway utilization and aircraft separation requirements.
- **Runway Use** - The percentage of time which each runway is in use.
- **Aircraft Mix** - The percentage utilization of the airfield by each aircraft class.
- **Percent Arrivals** - The percentage of total arrivals to departures during peak hours.
- **Percent Touch-and-Go** - The percentage of total aircraft operations that are touch-and-go training operations.
- **Exit Taxiway Locations** - The locations of exit taxiways for landing aircraft.

METEOROLOGICAL CONDITIONS

Weather conditions at an airport have a significant effect on the utilization of the runways and, consequently, affect the capacity of the runway system. Runway utilization at the airport is dictated by wind conditions, cloud ceiling, and visibility. The direction of takeoffs and landings is generally determined by the prevailing winds. The type of instrumentation and adequacy of the approach for each runway end also influence the choice of runway for use during inclement weather conditions.

Capacity of a runway system varies according to weather conditions. As weather conditions deteriorate, the capacity of a runway will decrease as well, until weather conditions become so poor that aircraft cannot attempt to takeoff or land. There are various types of instrument approach systems available which increase the ability of an airport to remain operational during deteriorating weather conditions. These instrument approach systems and approach procedures are also considered in the analysis of runway capacity.

For capacity calculation purposes three types of weather conditions are categorized for every airport. Visual Flight Rule (VFR) conditions exist when cloud ceilings are in excess of 1,000 feet above the airport and a runway visibility is more than three miles. Whenever the weather is reduced to conditions below 1,000-foot ceilings and/or three miles visibility, Instrument Flight Rule (IFR) conditions are said to exist. Poor Visibility and Ceiling (PVC) conditions are said to exist if the weather deteriorates to ceilings of less than 500 feet and/or visibility is less than one mile.

According to airport records IFR conditions occur approximately five percent of the time in the Show Low area. Show Low Municipal Airport has the procedures and equipment that enables it to remain open during most IFR conditions. The airport cannot remain open during PVC conditions, since the minimums on the approach procedure are greater than PVC minimums. The capacity of Show Low Municipal Airport is based on VFR and IFR conditions. The occurrence of PVC conditions has been included in the occurrence of IFR which may slightly overstate the capacity of the airport.

RUNWAY USE

Runway use is expressed in terms of the number, location, and orientation of active runways. It involves directions and kinds of operations using each runway. To maximize capacity at Show Low Municipal Airport, two runways can be used when conditions allow. During high wind conditions, general aviation operations are conducted along the runway alignment providing the best crosswind coverage.

AIRCRAFT MIX

Airport capacity is also dependent on the types of aircraft forecast to use the facility. Aircraft approach speed and landing distance each affect runway occupancy times. The longer aircraft remain on the runway the less capacity the airport has to accommodate arriving and departing aircraft. Therefore, aircraft mix is a major factor in the procedure to calculate airport capacity.

The airside capacity methodology identifies four classes into which aircraft are categorized. Classes A and B include small propeller aircraft and business jets weighing 12,500 pounds or less that are typical of general aviation. Classes C and D consist of large jet and propeller aircraft generally associated with airline and military use.

Based upon the forecasts of demand presented in the previous chapter, the current and projected aircraft operational mix for Show Low Municipal Airport is presented in Table 4A.

Table 4A

Aircraft Operational Mix (%)
Show Low Municipal Airport

Year	Class A	Class B	Class C	Class D
Existing	89	9	2	0
1995	86	10	4	0
2000	80	14	6	0
2005	74	18	8	0
2010	67	23	10	0

PERCENT ARRIVALS

The percentage of all aircraft operations that are arrivals has an important influence on the hourly capacity of a runway. For example, a runway used exclusively for arrivals will have a lower capacity than a runway used exclusively for departures. The hourly capacity of a runway is generally lower the higher the percentage of arrivals. At Show Low Municipal Airport, arrivals were estimated to be 50 percent of the peak hour operations.

PERCENT TOUCH-AND-GOS

A touch-and-go operation refers to an aircraft which lands and then immediately takes off without coming to a full stop or exiting the runway. Touch-and-go activity is counted as two operations since both an arrival and a departure are conducted. Touch-and-go's can be a significant component of the total operations at an airport and affect the capacity of the airfield significantly. The capacity would be increased since runway occupancy times are minimized for this type of operation. At Show Low Municipal Airport, touch-and-go activity is relatively low due to the lack of any significant amount of pilot training activity. The Touch-and-Go activity is projected to remain relatively constant at approximately ten percent of the total operations throughout the planning period.

EXIT TAXIWAY LOCATIONS

The most notable characteristics considered in the airside capacity model, outside of the runway configuration, are the number and types of taxiways available to exit the runway. The location of exit taxiways affects the runway occupancy time of an aircraft. The longer a plane remains on the runway, the lower the capacity.

The runways at Show Low Municipal Airport do not have a sufficient number of properly located exit taxiways to minimize runway occupancy times. Runway 6-24, which is 6,000 feet in length has one turnoff point which qualify as an exit taxiway whether landing on Runway 6 or 24. Runway 3-21 is 3,920 feet long and has one turnoff that qualifies as an exit taxiway. Qualifying exit taxiways are located between 2,000 and 4,000 feet from the approach end of a runway. Runway capacities could be increased by providing additional exit taxiways on both runways.

CAPACITY ANALYSIS

The preceding information was used in conjunction with the airside capacity methodology to determine the airfield capacity at Show Low Municipal Airport. Three separate results were obtained from the analysis.

- Hourly Capacity of Runway
- Annual Service Volume
- Annual Aircraft Delay

From these results it is possible to determine the adequacy of the current airfield to accommodate potential demand scenarios and to determine the range of aircraft delay associated with each demand level.

HOURLY RUNWAY CAPACITY

The first step of the analysis involved the computation of an hourly runway capacity for each potential runway use configuration. Wind direction, and the percentage of IFR and PVC weather then become important factors in determining the weighted hourly capacity of the airfield.

Based upon the existing runway system, an aircraft mix of two percent Class C operations, ten percent touch-and-go's, and a taxiway exit rating of one, the existing weighted hourly capacity was determined to be approximately 96 operations.

In the future, the percentage of Class C aircraft will grow to approximately ten percent. The percentage of touch-and-go activity is also expected to remain at approximately ten percent. This will result in the weighted hourly capacity decreasing to 95 operations. The weighted hourly capacities are compared to forecast design hour service volumes in Table 4B.

ANNUAL SERVICE VOLUME

Once the weighted hourly capacity is known, the Annual Service Volume (ASV) can be determined. Annual Service Volume is calculated by the following equation:

$$ASV = C \times D \times H$$

C = weighted hourly capacity.
D = ratio of annual demand to average daily demand during the peak month.
H = ratio of average daily demand to average peak hour demand during the peak month.

As mentioned earlier, the weighted hourly capacity is currently 96 operations per hour. In the future, a slightly heavier aircraft mix will reduce it to 95 operations as shown in Table 4B. The current Annual Service Volume for Show Low Municipal Airport was determined to be approximately 192,600 operations.

As annual activity increases and aircraft delays become greater, the annual service volume will begin to decrease. By 2010 it is expected that the existing runway system will have an annual service volume of 190,000 operations. It is evident from Table 4B that Show Low Municipal Airport will not exceed runway capacity before the end of the planning period.

Table 4B
Airfield Capacity/Delay Summary
Show Low Municipal Airport

	Demand		Capacity		Delay	
	Annual Operations	Design Hour Operations	Annual Service Volume	Weighted Hourly Capacity	Avg. Delay/ Operation (minutes)	Total Annual (hours)
Existing	18,000	9	192,600	96	0.05	15
1995	24,500	12	194,800	95	0.07	29
2000	28,900	15	183,800	95	0.08	39
2005	34,500	17	191,900	95	0.09	52
2010	40,200	20	190,000	95	0.12	80

ANNUAL AIRCRAFT DELAY

Even before an airport reaches capacity, it begins to experience certain amounts of delay to aircraft operations. Delays occur to arrival traffic that must wait in the traffic pattern or in an IFR holding pattern awaiting their turn to land. Departing traffic must hold on the taxiway or the holding apron while waiting for the final approach and runway to be cleared. As the operations at an airport grow toward capacity, delay increases exponentially. Total delay at Show Low Municipal Airport is currently estimated to be 15 hours annually. By the year 2010, annual aircraft delay should increase to a total of 80 hours. Table 4B compares the delay related to each of these scenarios. The existing level of delay is considered low and is expected to stay well within acceptable levels without capacity enhancements.

CAPACITY AND DELAY SUMMARY

Generally FAA recommends consideration of development of improvements for capacity when annual operations reach 60 percent of

Annual Service Volume. By the end of the planning period, operations at Show Low Municipal Airport are forecast to reach approximately 20 percent of Annual Service Volume. Therefore, no additional runways will be necessary for capacity purposes.

AIRSIDE FACILITY REQUIREMENTS

Airside facility requirements include those facilities directly related to the arrival and departure of aircraft:

- Runways
- Taxiways
- Airfield Instrumentation and Lighting

The selection of the appropriate FAA design standard for the development of airfield facilities is based primarily upon the characteristics of the most demanding aircraft expected to use the airport. The most critical characteristics are the approach speed and the wingspan of the critical aircraft anticipated to use the airport both today and in the future. The planning for future aircraft use is particularly important because design standards are used to plan separation distances between facilities that could be extremely costly to relocate at a later date.

According to **Airport Design**, FAA Advisory Circular 150/5300-13, aircraft are grouped into five categories based upon their certified approach speed. These categories range from Category A for slower single engine piston aircraft, to Category E for supersonic jet aircraft. The predominant aircraft using Show Low Municipal Airport today, fall into Categories A and B (approach speeds less than 121 knots).

The same advisory circular also defines six Airplane Design Groups (ADGs) according to the physical size of the aircraft. The airplane's wingspan is the principal characteristic affecting design standards. Airplane Design Groups range from Group I for small aircraft with wingspans less than 49 feet to Group VI for the largest cargo aircraft. The majority of aircraft using Show Low Municipal Airport fit into Group's I and II (wingspans less than 79 feet).

General aviation airports are divided into two major design classifications -- Utility and Transport. A Utility Airport is an airport designed, constructed and maintained to serve airplanes in Aircraft Approach Category A and B. Transport Airports are designed, constructed, and maintained to serve airplanes in Aircraft Approach Categories C and D. Each of these classifications are further subdivided by design aircraft size, weight, and speed.

- BASIC UTILITY - This type of airport accommodates small, single engine and small twin-engine airplanes, less than 12,500 pounds gross weight, used for personal and business purposes. The length of the runway will determine how many types of these aircraft will be able to operate at the airport. Aircraft that will use this class of airport will typically have wingspans less than 49 feet and approach speeds of less than 121 knots. Precision instrument approach systems are usually not planned for airports in this category.

- GENERAL UTILITY - This type of airport accommodates all small airplanes and some larger aircraft weighing more than 12,500 pounds with wingspans up to 79 feet and approach speeds of less than 121 knots. Precision instrument approach systems may be installed at airports in this category.

- TRANSPORT - This type of airport is designed for larger aircraft with higher approach airspeeds up to 166 knots. Typical wingspans vary from less than 49 feet up to 262 feet. Precision instrument approach operations are normally planned for most Transport airports.

Show Low Municipal Airport is classified by the FAA in its National Plan of Integrated Airport Systems (NPIAS) as a General Utility Airport. The design classification, the forecast activity at the airport, and the growth of the region clearly indicates the need to develop airport facilities beyond their current capabilities. The forecasts of future aviation activity at Show Low Municipal Airport indicate that the airport should be planned, as a Transport Airport and accommodate aircraft weighing up to 60,000 pounds.

In planning the future of Show Low Municipal Airport, the widest possible range of operating requirements and capabilities have been retained. This will provide maximum flexibility to develop the airport beyond the projected needs and the ability to respond to unforeseen events. This "built-in" flexibility can be achieved without sacrificing utility or economy, or over designing airfield facilities. However, it should be noted that external factors yet to be considered may impose physical, technical, or economic constraints on the recommended airport development.

In accordance with the FAA design criteria established in **Airport Design**, Show Low Municipal Airport will be designed to accommodate aircraft in Airplane Design Group III (ADG III) which includes aircraft with wingspans up to 118 feet and Approach Category C which includes aircraft with landing approach speeds of less than 141 knots. The facility requirements determined in this chapter will identify the unconstrained facility development that should be provided to fully accommodate the forecast aviation demand.

Airport design specifications are more specifically determined by analyzing the aircraft mix and determining the most demanding airplane(s) to be accommodated. Although one aircraft may determine runway length, another may define runway pavement strength or other appropriate design parameter. The following paragraphs detail the criteria used to establish airfield dimensions, capabilities, and requirements.

RUNWAYS

The adequacy of the existing runway system was analyzed from a number of perspectives including runway orientation, runway length, and pavement strength. From the prevailing local conditions and the forecast of aviation activity, the requirements for runway improvements were determined for Show Low Municipal Airport.

Runway Orientation

The existing runway system at Show Low Municipal Airport consists of a paved runway aligned generally east/west (Runway 6-24) and a paved runway aligned northeast/southwest (Runway 3-21). As a general rule, the primary runway is oriented, as closely as practical, in the direction of the prevailing winds. It is most desirable for aircraft to land directly into the wind whenever possible. This reduces the amount of runway required to stop the airplane and eliminates undesirable crosswinds. Aircraft are able to operate within a reasonable margin of safety as long as the crosswinds do not become excessive.

Crosswinds can be broken down into two components; a component parallel to the runway, and a component perpendicular to the runway. For planning and design purposes, crosswinds are considered excessive when the component of the winds perpendicular to the runway (crosswind) exceeds 15 miles per hour (13 knots) for aircraft over 12,500 pounds gross takeoff weight and at 12 miles per hour (10.5 knots) for smaller aircraft.

Federal Aviation Administration planning standards indicate that an airport should be planned with the capability to operate under year around wind conditions at least 95 percent of the time. This can often require more than a single runway depending on the wind patterns in the local area.

An analysis of historical wind data for 1989 at Show Low Municipal Airport indicates that Runway 6-24 provides 85.95 percent and 89.20 percent coverage for 12 and 15 mph crosswind components respectively. Runway 3-21 provides coverage of 90.25 percent for 12 mph and 93.34 percent for 15 mph winds. Neither of the existing runways individually can provide satisfactory crosswind coverage. These two runways combined provide 90.72 and 93.74 percent crosswind coverage for 12 and 15 mph crosswinds respectively.

The stronger winds are predominantly out of the south and would favor the use of Runway 21. A single runway oriented in a north/south direction could provide the desired crosswind coverage. A Runway 17-35 (oriented 186 degrees true) would produce a crosswind coverage of 97.64 percent for 12 mph winds 98.64 for 15 mph winds. Table 4C presents the data that these crosswind coverages are based upon.

Table 4C
Wind Data
Show Low Municipal Airport (1989)

Direction (True)/ Speed (Knots)	Calm	1-3	4-6	7-10	11-16	17-21	22-27	28-33	34-40	41+	Total
10			.07	.17	.07	.05					.37
20			.22	.22	.17	.07	.02				.72
30		.07	.25	.27	.07						.67
40		.02	.20	.22	.05	.05					.55
50			.12	.12	.02		.02				.30
60			.10	.15	.05	.02	.05		.02		.40
70			.05	.07	.05						.17
80			.10	.12	.02						.25
90			.12	.02	.02	.02					.20
100			.07	.07	.07		.02				.25
110			.02	.07							.10
120			.12	.07	.05			.02			.27
130		.02	.12	.05		.02	.02	.02			.27
140			.10	.12	.12	.05					.40
150			.15	.27	.10	.12					.65
160		.02	.10	.87	.40	.25	.02	.05			1.72
170		.02	.20	1.52	.65	.55	.22	.17	.10	.05	3.49
180			.42	1.97	1.84	1.32	.55	.35	.35	.05	6.85
190			.17	1.17	1.00	.55	.30	.20	.20	.07	3.66
200		.02	.32	.97	.87	.55	.20	.10	.05	.02	3.11
210			.20	.70	.52	.32	.12	.05	.05		1.97
220			.17	.32	.30	.12	.05		.02		1.00
230			.17	.52	.07	.02	.02	.05			.87
240		.02	.42	.42	.15	.05	.02				1.10
250		.02	.15	.20	.12		.02				.52
260		.02	.20	.30				.02			.55
270		.02		.10	.02						.15
280		.05	.12	.20	.02						.40
290			.20	.20	.07	.02					.50
300			.32	.40	.25	.07		.07			1.12
310			.15	.35	.07						.57
320		.05	.37	.32	.07	.02	.02				.87
330			.55	.60	.07	.02	.02				1.27
340		.05	.35	.75	.25	.05					1.44
350		.10	.52	.87	.12	.07					1.69
360	58.37	.10	.77	1.64	.45	.25					3.21
TOTAL	58.37	.65	7.74	16.46	8.24	4.68	1.74	1.12	.80	.20	100.00

Note: Data adjusted to construct a 24 hour wind rose from daily (8:00 am to 5:00 pm) wind observation records. Totals may not add due to rounding.

Runway Length

The ultimate runway length will determine the types of aircraft that will be able to operate at Show Low Municipal Airport. Runway length requirements are based upon four primary factors:

- The types of aircraft expected to use the runway.
- The mean maximum daily temperature of the hottest month.
- The airport elevation.
- The effective runway gradient.

At Show Low Municipal Airport, the mean maximum daily temperature of the hottest month (July) is 86 degrees Fahrenheit and the airport elevation is 6411 feet above mean sea level (MSL). Runway 6-24 has an effective runway gradient of 0.0033 percent sloping to the east and Runway 3-21 has an effective runway gradient of 0.33 percent sloping to the northeast.

Given the above conditions of climate and topography, runway lengths can be calculated for various types and groupings of aircraft. The existing runway length of 6,000 feet for Runway 6-24 exceeds only one of the standard runway lengths for utility airports (BUI). However, it does provide sufficient length to accommodate most single and twin-engine airplanes and many business jet aircraft except under extreme conditions. The standard runway lengths for the various categories of utility runways are shown in Table 4D. Runway lengths for crosswind utility runways should be at least 80 percent of the primary runway length.

Runway length requirements for transport runways are not only determined by the previously mentioned climatological factors, but are also based on the percentage of the business jet fleet the runway is expected to accommodate. The fleet percentage values are based on groupings of the business jet aircraft fleet weighing less than 60,000 pounds. Additionally, the loading conditions (the percentage of useful load) under which these aircraft are expected to operate greatly influences the amount of runway required to operate safely from the airport. Table 4D also illustrates the standard runway length requirements for Show Low Municipal Airport in order to accommodate various segments of the business jet fleet under standard loading conditions.

Table 4D
Runway Length Requirements
Show Low Municipal Airport

Utility Runway	Runway Length
Basic Utility I	5,500 ft.
Basic Utility II	7,800 ft.
General Utility I	7,800 ft.
General Utility II	7,800 ft.

Transport Runway

Percent of Business Jet Fleet	Percent of Useful Load	Runway Length
75	60	7,200 ft.
75	90	8,600 ft.
100	60	11,000 ft.
100	90	11,000 ft.

Comparing the standard runway length requirements for the general aviation fleet, it is obvious that 7,800 feet of runway length should be provided to fully accommodate the widest possible range of general aviation demands. A 7,800 foot runway could accommodate 100 percent of the small general aviation fleet and 75 percent of the turbojet fleet operating up to approximately 75 percent useful load.

The total 7,800 feet of runway length may not be possible in the short term, however, additional runway length is currently needed to provide a wider margin of safety for piston aircraft and a wider operating range for business jets. Even at this length some small piston engine aircraft will still be unable to operate from Show Low Municipal Airport under high temperature conditions. An intermediate runway length of 7,000 to 7,200 feet would safely accommodate most smaller jets and some larger aircraft under restricted operating limits.

Given the topographical constraints at Show Low Municipal Airport a more detailed analysis of runway length requirements was performed. Runway length requirements and/or takeoff weight restrictions were determined for various individual aircraft. The takeoff requirements for a sampling of aircraft commonly used by commuter airlines is contained in Table 4E. This data should not be considered to be actual aircraft performance since a great number of other variables must be considered. However, they do indicate the range of conditions, under which these aircraft can operate.

Table 4E

Runway Length Requirements - Individual Aircraft
Show Low Municipal Airport

Aircraft	Takeoff Weight	Flap Setting	Runway Length (FT)
De Havilland Dash 7	44,000[1]	15°	7,200
De Havilland Dash 7	42,500[2]	25°	6,000
De Havilland Dash 8-100	31,800[1]	0°	7,300
De Havilland Dash 8-100	30,000[2]	0°	6,000
De Havilland Dash 8-300	36,800[1]	0°	7,700
De Havilland Dash 8-300	36,600[2]	10°	6,000
Beech 1900	16,600[1]	Takeoff	4,000
Beech 200	12,500[1]	40°	3,500
EMB 120	9,600[1]	15°	5,900
BAE 146-100	82,250[1]	24°	7,400
BAE 146-100	77,000[2]	30°	6,000
BAE 146-200	76,000[2]	30°	6,000
B737-300	110,000[2]	TBD	6,000

1 Maximum takeoff weight for aircraft and/or aircraft at airport elevation.
2 Maximum takeoff weight for aircraft and/or aircraft at airport elevation with 6,000 feet of runway available.

All of the above aircraft can operate safely from a 6,000 foot runway, However, most of them will have takeoff weight restrictions. These restrictions will vary in degree from a few hundred pounds for a Dash-8, to 25,000 pounds for a 737-300. In the case of the 737-300 a 6,000 foot runway would enable the aircraft to operate with a 40,000 pound useful load.

Examination of the runway length requirements in Table 4D would suggest that an adequate runway length for the majority of these aircraft would be 7,000 and 7,500 feet. This runway length would enable most of these aircraft to operate at or near their maximum takeoff weights.

Given the relatively short distances that most aircraft departing Show Low Municipal Airport will be traveling, the need to operate at maximum gross weight is reduced. Couple this with temperatures less than mean maximum daily of the hottest month, and the maximum takeoff weights are increased or the runway length requirements are reduced.

Based on the data contained in Table 4D and 4E a minimum of 7,000 feet of runway should be provided at Show Low Municipal Airport. The optimum runway length of 7,800 feet should ultimately be provided, when business jet activity reaches approximately ten percent of annual operations.

Runway Width

Runway width requirements are based on the category of aircraft the runway is intended to serve. Runways intended to serve utility category aircraft should be a minimum of 60 feet wide. The 60 foot width is adequate for all aircraft in ADG I. If the runway is to serve aircraft in ADG II, the runway width should be increased to 75 feet.

For transport category aircraft, the minimum runway width is 100 feet. The 100 foot width can accommodate all aircraft with wingspans up to 118 (ADG III) and gross takeoff weights less than 150,000 pounds. The runways at Show Low Municipal Airport should be planned to be 100 feet wide for transport runways and 75 feet wide for all utility runways.

Runway Pavement Strength

Both runways at Show low Municipal Airport have a rated pavement strength of 12,500 pounds (Single Wheel). A 12,500 pound pavement strength would permit limited use by smaller business jet aircraft, however, for continuous use by these aircraft or use by larger business jet aircraft, the strength of the runway pavement should be increased to 60,000 pounds (DW). The ultimate recommended pavement strengths should be 12,500 pounds (SW) for utility runways and 60,000 pounds (DW) for transport runways.

TAXIWAYS

Taxiways are constructed primarily to facilitate aircraft movements between the runway system and the terminal area. Some taxiways are necessary simply to provide access between the parking apron and runways, whereas others become necessary as activity increases to relive traffic congestion and provide more efficient circulation around the airfield.

Each runway should have a full length parallel taxiway situated so as to minimize taxiway distances and runway crossings. Taxiways should also provide the most direct route from the terminal area to the runway in use. In addition, there should also be a sufficient number of exit taxiways to minimize runway occupancy times. These exit taxiways should be strategically located along the runway for the types of aircraft expected to use the runway. Taxiways that will serve ADG II aircraft should be a minimum of 35 feet wide.

Taxiways should be designed to have the same pavement strengths of the runway they serve. If the taxiway is to be utilized primarily by business jets, an ultimate 60,000 pound (DW) pavement strength will be necessary. Taxiways designed to serve only small general aviation aircraft (ADG I) can be reduced to 25 feet in width. Taxiways used exclusively by small aircraft should have a minimum pavement strength of 12,500 pounds (SW).

Holding aprons can be provided for taxiway bypass capability near the ends of the taxiway to minimize delays to departing aircraft. Holding aprons allow aircraft to pass other aircraft involved in an extended preflight check.

AIRFIELD INSTRUMENTATION AND LIGHTING

Navigation aids provide two primary services to airport operations; precision guidance to a specific runway; or nonprecision guidance to a runway or the airport itself. The basic difference between a precision and nonprecision navigational aid is that the former provides electronic descent, alignment (course), and position guidance while the nonprecision navigational aid provides only alignment and position information. The necessity of such equipment is usually determined by design standards predicated on safety considerations and operational needs. The type, purpose and volume of aviation activity expected at the airport are factors in the determination of the eligibility of the airport for navigational aids.

Airport and runway navigational aid requirements are based upon FAA recommendations as depicted in **Airway Planning Standards Number One**, DOT/FAA Handbook 7031.2B, and **Airport Design**. The existing navigational aid (Navaid) at Show

Low Municipal Airport consists of a Nondirectional Radio Beacon (NDB). The NDB is used for both enroute and terminal navigation. An instrument approach procedure has been established that uses this navaid as the basis for navigation. The NDB-A approach is a nonprecision circling approach to the airport from the northeast. This approach procedure provides circling weather minimums which are slightly lower than visual minimums.

As aviation activity continues to increase, approaches to other runways will become necessary to provide adequate capacity during IFR conditions. Final recommendations for any additional approaches will be dependent upon the analysis of future development alternatives and the final airport development concept. However, at a minimum, a nonprecision instrument approach aid capable of providing a straight-in approach procedure should be provided.

Visual glide path indicator lights are a system of lights which provide visual descent guidance information during an approach to the runway. Currently only Runway 6-24 is equipped with Precision Approach Path Indicators (PAPI). PAPI's, or other approved visual approach aids, should be planned for all runway ends.

Runway End Identifier Lights (REIL) are installed to provide rapid and positive identification of the approach end (threshold) of a runway. Currently, only Runway 6-24 at Show Low Municipal Airport is equipped with REIL's. REIL's should be considered for all runway ends not equipped with an approach light system.

The existing runway and taxiway lighting systems at Show Low Municipal Airport are limited to Medium Intensity Runway Edge Lighting (MIRL) on Runway 6-24. This lighting system is recommended for all visual and nonprecision instrument runways. When a precision instrument approach aid is installed High Intensity Runway Edge Lighting (HIRL) is usually provided. Ultimately both an approach light system and HIRL should be installed on any precision instrument runway at Show Low Municipal Airport.

Medium Intensity Taxiway Edge Lights (MITL) should ultimately be installed on all taxiways. Installation of reflective edge markers along all sections of unlighted pavement is recommended as a low cost interim measure prior to installation of edge lights. These reflective markers will improve the safety of nighttime aircraft movements on the airport and help eliminate inadvertent taxiing off of paved surfaces.

LANDSIDE FACILITY REQUIREMENTS

Components of the general aviation landside complex include the following types of facilities:

- Hangars
- Parking Apron
- Terminal Building
- Automobile Parking
- Fuel Storage

The capacities and capabilities of the various components of the existing terminal area are examined in relation to projected demand to identify future landside facility needs.

HANGARS

The demand for hangar facilities is dependent upon the number and types of aircraft expected to be based at the airport. Actual percentages of based aircraft desiring hangar facilities will vary across the country as a function of local climatic conditions, airport security, and owner preferences. This percentage will also vary with value and sophistication of the aircraft, and will typically range anywhere from 30 to 80 percent.

Hangar facilities are generally classified as conventional hangars, T-hangars, or shades. These different types of hangar facilities offer varying degrees of privacy, security, and protection from the elements. All of the existing hangar facilities at Show Low Municipal Airport are currently occupied. Show Low Municipal Airport currently has approximately 75 based aircraft and only 10 percent of these aircraft are currently stored in hangars.

Show Low has a large percentage of seasonal or part time aircraft based at the airport. These part time aircraft will not have as great a demand for hangar facilities as permanent aircraft, therefore, a relatively small percentage of the single engine aircraft are expected to desire hangar storage. For planning purposes, it was assumed that 25 percent of the single engine, 50 percent of the twin-engine, and 100 percent of the helicopters and turbine powered aircraft would desire hangar storage. Further, it was assumed that all individual aircraft storage would occur in T-hangars or small private hangars. Space for up to five percent of the based aircraft will also be provided for conventional maintenance hangar capacity. This maintenance hangar area will be in addition to the individual hangar facilities, and can normally be provided by an FBO.

Table 4F outlines the projected hangar requirements throughout the planning period. A planning standard of 1,250 square feet per aircraft was used for individual hangar storage. Space requirements for conventional hangar storage were based upon 1,000 square feet per piston and rotor aircraft and 2,000 square feet per turbine aircraft. In addition, hangar service area is estimated at 15 percent of the total hangar storage area available. Significant additional conventional and T-hangar facilities will be required throughout the planning period.

Table 4F
Hangar Facilities
Show Low Municipal Airport

	Existing 1989	1995	2000	2010
Based Aircraft:	75	97	107	134
Single Engine	70	88	95	114
Multi-Engine	4	6	9	10
Helos & Turbine	1	3	4	10
Aircraft to be Hangared	9	28	32	44
Hangar Positions:				
Single Engine	6	22	24	29
Multi-Engine	2	3	5	5
Helos & Turbine	1	3	4	10
Hangar Area:(sq.ft.)				
Aircraft Storage	7,500	35,000	40,000	55,000
Aircraft Maintenance	2,500	1,450	1,650	2,250
Hangar Service Area	1,000	5,500	6,250	8,600

AIRCRAFT PARKING APRON

Adequate aircraft parking apron should be provided to accommodate those local aircraft not stored in hangars as well as transient aircraft. At Show Low Municipal Airport apron and tiedown areas are available for both local and transient aircraft, however these facilities are not separated. Local based aircraft are parked in all three apron areas. Transient aircraft are parked primarily on the center apron.

The mix of local and transient parking is not recommended. Transient parking should be located nearest the terminal and fuel facilities for convenience and service, while local parking may be located further away. Local and transient parking areas may be contiguous but should not be mixed, particularly when activity increases.

Transient parking requirements can be determined from a knowledge of busy-day operations. The number of transient spaces required at Show Low Municipal Airport was determined to be about 50 percent of the busy-day itinerant operations. A planning criterion of 300 square yards per based aircraft and 360 square yards per transient aircraft was used for the analysis presented in Table 4G. The analysis indicates a need for additional transient parking apron throughout the planning period.

Of the 151 tie-downs currently available at Show Low Municipal Airport, 100 have been assumed to be for local aircraft and 51 are considered to be for transient aircraft. If this allocation of tie-downs remains, local aircraft parking should be adequate throughout the planning period. However, the transient parking apron will need to be expanded in the future as traffic increases. In particular the apron north of the existing terminal building will need to be expanded to take better advantage of the runway frontage and improve circulation around the terminal building.

Table 4G
Aircraft Parking Apron Requirements
Show Low Municipal Airport

	Available 1989	1995	2000	2010
Local Apron:				
Non-hangared Aircraft	66	69	75	90
Local Parking Positions	100	69	75	90
Tiedown Area (s.y.)	30,000	20,700	22,500	27,000
Transient Ramp:				
Busy-Day Itinerant Operations	63	84	100	139
Transient Parking Positions	51	42	50	70
Apron Area (s.y.)	18,400	15,100	18,000	25,200

TERMINAL BUILDING

General aviation terminal buildings serve several functions. Space is required for administrative and management offices, pilot's lounge and flight planning area, meeting facilities, food services, storage rooms, restrooms and various other needs. This space is not necessarily limited to a single building. In the case of Show Low Municipal Airport, these facilities and services are currently provided in combination by the City of Show Low and local commercial interests.

The methodology utilized to examine terminal building capacity generally relates square footage requirements for terminal facilities based on the number of design hour general aviation pilots and passengers. Space requirements were determined using 100 square feet per design hour pilot and passenger. Table 4H outlines the terminal space requirements for general aviation terminal facilities at Show Low Municipal Airport during the planning period. Terminal facilities and services may be provided in more than one location, and by more than one provider.

Table 4H
General Aviation Terminal Building
Show Low Municipal Airport

	Available 1989	1995	2000	2010
Design Hour Passengers	21	28	35	46
Total Terminal Area (s.f.)	760	2,800	3,500	4,600

Although terminal space requirements are usually based on a square footage per passenger basis, certain minimum facilities must be provided regardless of passenger volume. Due to the relatively small passenger volume at Show Low Municipal Airport, the figures in Table 4H do not reflect reasonable space requirements until late in the planning period. A minimum general aviation terminal building capable of accommodating all necessary facilities and services, regardless of how small the passenger volumes, should consist of at least 3,500 to 4,000 square feet.

Various services and facilities can be provided in multiple structures by private and public sources, however, duplication of required facilities may make this undesirable. Therefore, public and private development must be closely coordinated to provide the necessary facilities without over building.

AUTOMOBILE PARKING

The requirements for short term (daily) public vehicle parking may also be determined as a function of the design hour pilots and passengers. The total number of parking positions are usually projected on the basis of 1.3 spaces per design hour passenger and 350 square feet per automobile parking space.

The requirements for long term (monthly) automobile parking are less explicit and more varied. At Show Low there is a very high percentage of seasonal residents and based aircraft. These part time residents and pilots often leave automobiles at the airport for extended periods. Almost 75 percent of the based aircraft at Show Low Municipal Airport are part time and most keep at least one vehicle at the airport on a long term basis. Therefore, long term parking requirements will be based on 75 percent of the based aircraft at the airport.

Table 4I reflects parking facilities that are currently available and those that will be required in the future. Presently, there is approximately 40,000 square feet of unpaved parking area available which is capable of parking about 120 vehicles. This is slightly more than the planning standard but due to the large demand for long term parking, additional parking will likely become necessary during the short term of the planning period.

Plans are currently being developed to pave and stripe at least a portion of the terminal parking area. Additional auto parking requirements will depend on the capacity of the current design and whether or not continued unpaved parking is permitted. In the future all subsequent landside development should provide adequate parking for its operations. These parking areas may be provided individually or in common with the other development depending on there proximity.

Table 4I

General Aviation Auto Parking Requirements
Show Low Municipal Airport

	Available 1989	1995	2000	2010
Design Hour Passengers	21	28	35	46
Based Aircraft	75	97	107	134
Short Term Auto Parking	15	36	46	60
Long Term Auto Parking*	105	73	80	100
Total Auto Parking	120	109	126	160
Auto Parking Area (s.f.)	40,000	38,150	44,100	56,000

* This does not include the approximate 100 permanent cars.

FUEL STORAGE

The active aircraft fuel storage facilities on the airport currently consist of one 10,000 gallon underground tank. This tank is used Lead fuel. Additional fuel storage can be made available from a 10,000 gallon underground storage tank that can be put into service with a minimum of improvements. The idle tank is intended to be used for Jet A grade fuel. The capacities of the fuel dispensing trucks are not considered permanent storage capacity.

Fuel consumption is directly related to the operational activity at an airport. General aviation fuel storage requirements were determined following analysis of current fuel consumption characteristics at Show Low Municipal Airport. The average consumption during 1989 was approximately 5.9 gallons per operation. This is slightly (approx. 20%) higher than normal for a general utility airport and indicates the extent of transient traffic at the airport. The higher fuel consumption rate is also indicative of a slightly higher occurrence of larger single engine and twin engine aircraft in the fleet mix.

Fuel storage capacity was calculated based on providing a two week fuel supply during the peak month of activity. These requirements are shown in Table 4J. Although the table shows fuel storage should be adequate during the initial stages of the planning period, additional general aviation fuel storage will be required by the end of the planning period. At the current rate of consumption, there is capacity to store more than a 30 day supply of fuel. In some cases it may be desirable to provide a minimum 30 day storage capacity in order to lesson the effect of spot shortages or to take advantage of price fluctuations. At a minimum, at least a 10,000 gallon storage capacity of each grade of fuel should be provided to eliminate partial fuel deliveries and excess freight costs.

Table 4J

General Aviation Fuel Storage Requirements
Show Low Municipal Airport

	Available 1989	1995	2000	2010
Design Day Operations	84	112	133	185
Peak Month Operations	2,200	2,900	3,470	4,820
Gallons/Operation	5.9	6.0	6.0	6.0
Fuel Storage (gals)	10,000	17,400	20,800	29,000

COMMERCIAL SERVICE FACILITIES

Show Low Municipal Airport currently has no commercial service facilities and is not served by a scheduled airline. However, there is a strong desire and commitment on the part of the City of Show Low and surrounding communities to attract and sustain commercial service to the White Mountain Region. If Show Low is successful in attracting an airline, adequate terminal facilities will be necessary.

Commercial service terminal area facilities are based on standard planning guidelines. These guidelines relate to the major functional areas of the terminal building (ticket counter, baggage, waiting area, etc.) These planning guidelines are presented in **Planning and Design of Airport Terminal Facilities at Nonhub Locations**, FAA Advisory Circular 150/5360-9. The key elements analyzed include the passenger terminal building, airline gate positions, and terminal apron area.

The methodology utilized in the analysis of passenger terminal buildings involves the relating of passenger demands to the amount of space required for various facilities. The evaluation process involves the major terminal building areas that are normally affected by peak hour activities.

As passenger volumes increase so to does the amount of terminal space required to adequately accommodate these passengers. Terminal space requirements are directly proportional to the volume of passenger demand, however, when passenger volumes are relatively low a lower limit is reached and a minimum area should be provided. The minimum space requirements provides an economical terminal building which allows for some growth in passenger traffic without minor additions to facilities.

Current considerations for airline service at Show Low are centered around commuter airlines operating 19 passenger aircraft. These aircraft are used extensively by commuter airlines and provide efficient service to rural communities. A minimum level of service would begin with two round trips per day to a major metropolitan area. Based on this type of service the maximum design hour passenger enplanements would be 19 passengers. This level of passenger demand is below all minimum passenger levels that would require additional space beyond the minimum space requirements.

It is not anticipated that more than one aircraft will require a parking position during any given period. However, in the event that an aircraft is delayed or disabled, a second apron parking position should be provided. This second gate position could also be required for an unscheduled chartered aircraft. The size of the apron parking position will depend on the wingspan of the aircraft and the maneuvering space needed. For planning purposes, 1,000 square yards per gate will be provided.

The major terminal building facilities and the minimum space requirements for each functional area are illustrated in Table 4K. These facilities and areas are in addition to the general aviation terminal facilities discussed earlier.

Table 4K
Airline Passenger Terminal Building
Show Low Municipal Airport

	Minimum
Design Hour Enplanements	19
Airline Gate Positions	2
Gate Apron Area (s.y.)	2,000
Terminal Building:	
Waiting Lobby (s.f.)	800
Airline Office/Operations (s.f.)	1,200
Ticket Counter Lobby (s.f.)	300
Baggage Claim Lobby (s.f.)	500
Concessions (s.f.)	500
Mechanical/Storage (s.f.)	500
Sterile Area (s.f.)	200
Total Terminal Space (s.f.)	**4,000**
Auto Parking Spaces	50

UTILITIES

The existing water and waste waster systems were examined for their capacity to meet the long term demands of the airport. Domestic water is supplied by the City of Show Low Water Department and sewage disposal is accomplished through a combination of sewer and septic tank. The terminal building is served by a newly installed sewer system and the existing FBO building is connected to a previously installed sewer line.

The existing water system is a six inch water main that supplies water to the terminal building and the FBO building. This system has adequate capacity to meet current demand and future development requirements. The existing water system dead ends at the terminal building and should be looped to provide consistent pressure and continuous service. Future development in the existing terminal area will need to be connected to the existing water distribution system. As development continues in the terminal area the service line should be looped to the main line adjacent to Highway 77.

The existing sewer system is adequate to serve the existing and future needs of the terminal area. There is an eight inch sewer line that extends from the terminal building along the new access road and connects with the main sewer line along Highway 60.

SUMMARY

As aviation activity continues to increase in the Show Low and White Mountain Area certain airport facilities will need to be improved or expanded. Several deficiencies have been identified in some of the facilities currently available at the airport. Principal among these is the need for additional runway length, terminal building, aircraft storage hangars, auto parking, and FBO facilities. The existing deficiencies will become more sever and additional deficiencies will develop in the near future as activity at the airport continues to increase. Therefore, measures must be taken to accommodate increased aviation activity.

Exhibit 4A and **Exhibit 4B** illustrate the extent to which the airport facilities should be developed throughout the planning period. The recommended development will not only improve or correct existing deficiencies, but also provide the modern and efficient facilities necessary to attract and encourage additional development and services.

The next step in the master planning process is to analyze various alternatives capable of providing the necessary facilities. Chapter Five will examine several alternatives, assess their relative strengths and weaknesses, and recommend a final concept for the future development of Show Low Municipal Airport.

	EXISTING	1995	2000	2010
RUNWAYS	6-24 6,000' x 75' 3-21 3920' x 60'	Primary 7000' x 75' (12,500 lb. SW) Crosswind 4000' x 75'	Primary 7000' x 100' (30,000 lb. SW) Same	Primary 7800' x 100' (60,000 lb. DW) Crosswind 5600' x 75'
TAXIWAYS	Taxiway 1 1300' x 42' Taxiway 2 2900' x 35'	Full Length Parallel on Primary Runway	Full Length Parallel on Crosswind Runway	All Necessary Crossover and Connecting Taxiways
NAVIGATIONAL AIDS	NDB REILs (Rwy 6-24)	Localizer transmitter	Same	Same
LIGHTING and MARKING	Beacon PAPI-2 (Rwy 6-24) MIRL (Rwy 6-24) Non Precision (Rwy 6-24) Visual (Rwy 3-21) Segmented Circle	MIRL and PAPI on Crosswind Runway	MITL on All Taxiways	Same

Exhibit 4A
AIRSIDE FACILITY REQUIREMENTS

Show Low
MUNICIPAL AIRPORT

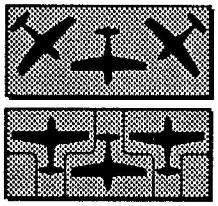
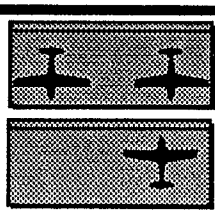
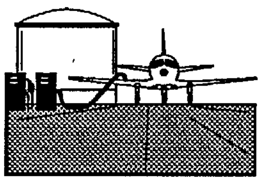
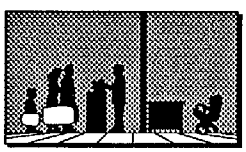
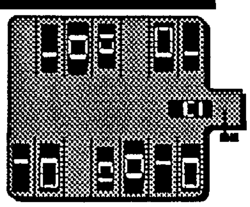
		EXISTING	1995	2000	2010
HANGARS 	Aircraft Positions	9	28	32	44
	Conventional Hangar	3	3	3	4
	T-Hangar	6	25	29	40
APRON TIE-DOWNS 	Local Ramp Positions	100	69	75	90
	Transient Ramp Positions	51	42	50	70
FUEL STORAGE 	Total Gallons	10,000	17,400	20,800	29,000
	Jet A (gallons)	10,000 (Unusable)	10,000	10,000	10,000
	AVGAS (gallons)	10,000	10,000	10,000	20,000
GENERAL AVIATION TERMINAL 	Total Area (Sq. Ft.)	760	2800	3500	4600
AUTO PARKING 	Parking Positions	120	109	126	160
	Short Term		36	46	60
	Long Term		73	80	100

Exhibit 4B
LANDSIDE FACILITY REQUIREMENTS

Show Low
MUNICIPAL AIRPORT